Report of 1928-1929 Color Committee

By W. D. HUTCHINS, *Chairman*

SUCH correspondence on the number of glasses which constitute a standard set of Lovibond Color Glasses and the number of individual glasses to be used for the determination of a color has been passed on to this Committee. The inherent defects of the method of color comparison, the many existing unstandardized variables, the confusion resulting from the standardization of the red color glasses, and the personal equation present makes this determination a very hard one to secure as concordant results as desired. The determinations are probably affected more and made less accurate by the above elements than the limit of error caused by the use of one, two or three glasses. However, the Committee has made an effort to recommend changes which would standardize some of the variables in the method and make it more definite.

The Committee considered the following points: Standard set of glasses; definite number of glasses used in each determination; type of tintometer; source of light and bulb; container for holding oil and filter paper. In addition to this, it was brought to our attention that Mr. Arthur C. Hardy of the Massachusetts Institute of Technology had designed a colorimeter or color analyzer which might be of interest to our Society. This matter was taken up with Mr. Hardy, and he advised as follows:

"This instrument is really a photoelectric spectrophotometer which automatically draws a spectrophotometric curve in about thirty seconds. Although it was designed originally to measure the color of opaque objects, it can be used equally well for the color of solutions. The precision of the instrument is some ten times or more better than that of the human eye. I am pleased to be able to inform you that the General Electric Company has very recently undertaken to build these machines in quantity. As you know, the development of a commercial instrument takes time and it may be several months before any announcement can be made with respect to the price or date of delivery. I am very glad to know of your interest and I shall make some tests along this line to determine the suitability of the instrument for your purposes. I have written a complete description of this instrument which will be published shortly in the Journal of the Optical Society of America. As soon as reprints are available I shall see that you obtain one." In later correspondence Mr.

COMPARATIVE READINGS SUBMITTED BY COMMITTEE

Sample	A Copes: Color Y.	Color R.	Red Glasses	B Schwartz: Color Y.	Color R.	Red Glasses	C Agee: Color Y.	Color R.	Red Glasses	Color Y.	Color R.	Red Glasses
1	10	1.1	2	8	0.8	1	20	0.9	1	20	0.7	1
2	35	2.1	2	20	2.6	1	20	2.5	2	20	2.7	2
3	35	3.1	2	35	3.4	2	20	3.6	2	20	3.8	2
4	35	5.0	1	35	4.9	2	35	4.8	2	35	4.8	2
5	35	6.3	2	35	6.5	2	35	6.4	2	35	6.2	2
6	35	7.8	2	35	8.2	1	35	7.8	2	35	7.6	2
7	35	10.5	2	35	10.9	2	35	10.8	2	35	10.2	2
8	35	16.5	3	35	16.1	3	35	16.1	1	35	16.0	3
9	35	18.7	3	35	20.5	2	35	18.7	2	35	18.3	3

Sample	D Grant: Color Y.	Color R.	Red Glasses	E Hutchins: Color Y.	Color R.	Red Glasses	Color Y.	Color R.	Red Glasses
1	8	1.1	2	6	1.0	1	6	1.1	1
2	25	2.2	1	20	2.2	1	20	2.0	1
3	35	3.3	2	35	3.1	2	35	3.0	1
4	35	4.3	2	35	4.5	1	35	4.5	1
5	35	5.7	2	35	6.0	1	35	6.0	1
6	35	7.4	2	35	7.6	1	35	7.6	1
7	35	9.9	2	35	10.1	2	35	10.1	2
8	35	15.4	3	35	16.0	1	35	16.0	1
9	35	21.0	2	35	18.7	2	35	19.0	2

A—Tintometer—Wesson Type, Eyepiece aperture ¼"; Palo North Skylight Lamp, 600 Watt clear glass and a blue filter. Readings average of two observers.
B—Tintometer—Emil Greiner.
C—Tintometer—Bailey Modification of Emil Greiner.
D—Tintometer—Wesson Type; 100 Watt Blue Frosted Bulb.
E—Tintometer—Emil Greiner; 150 Watt Daylight Bulb.
Note: One yellow glass used in each determination and only the glasses listed in standard set. All readings made at standard temperature and in tubes ¼" diameter.

Hardy was offered samples of oil on which to experiment, but in reply he advised that it would be some time next summer before the Color Analyzers will be available.

Nine samples of oil of various colors were submitted to the members of the Committee for examination, and they were asked to consider the points mentioned in the third paragraph in making these readings. A special request was made that they use only the glasses recommended in this report as a standard set. The results are given in the tabulation on page 19.

Mr. Schwartz made readings using different colors and different strength bulbs, and from the data given below, came to the following conclusion: Whether the bulb is frosted, blue or plain makes little difference provided we standardize on one. Observation has been that plain blue lamps give slightly darker readings than either the plain or frosted lamp. The 50 Watt lamp is too weak for oils as high as 20.0 red and 150 Watt is too powerful for oils lighter than 2.5 red. The 100 Watt Daylight lamp should be adopted as standard.

	75 Watt Frosted Bulb			75 Watt Plain Bulb			50 Watt Plain Bulb			75 Watt Daylight			150 Watt Daylight		
	Color		Red G.	Color		Red G.	Color		Red G.	Color		Red G.	Color		Red G.
Sample	Y.	R.		Y.	R.		Y.	R.		Y.	R.		Y.	R.	
1	8	0.8	1	8	0.9	1	8	0.9	1	8	0.8	1	8	0.9	1
2	20	2.3	1	20	2.3	1	20	2.4	1	20	2.6	1	20	2.4	2
3	35	3.4	2	35	3.4	2	35	3.4	2	35	3.4	2	35	3.5	2
4	35	4.6	2	35	4.6	2	35	4.6	2	35	4.9	2	35	4.6	2
5	35	6.1	2	35	6.0	1	35	6.1	2	35	6.5	2	35	6.3	2
6	35	7.5	1	35	7.5	1	35	7.5	1	35	8.2	1	35	7.8	2
7	35	10.4	1	35	10.4	1	35	11.0	2	35	10.9	2	35	10.5	2
8	35	16.1	3	35	15.7	1	35	16.6	3	35	16.1	3	35	15.6	2
9	35	20.5	2	35	20.2	1	35	21.3	3	35	20.5	2	35	20.3	2

The Committee makes the following recommendations to the Society:

1—That a standard set of Lovibond glasses consists of the following yellow and red glasses:

Yellow:	4.0 and 50.0	6.0	8.0	10.0	14.0	16.0	18.0	20.0	35.0
Red:	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
	1.0	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0
	7.6	8.0	9.0	10.0	11.0	12.0	16.0	and	20.0

2—That the following number of glasses be used to make a color determination: Only one yellow glass, not more than two red glasses up to and including 13.0 red; not more than three red glasses above 13.0 red.

We see no reason why the determination of grade should not be made with the above glasses instead of one yellow and one red as specified in the present rule unless this Society is prepared to find a way to supply the glasses of the exact standard. The present glasses such as 7.6 red and 12 red, when standardized by the Bureau of Standards, are found to be off. This necessitates the using of other glasses.

3—That the Society adopt the Enclosed Wesson Type Tintometer. We realize that this tintometer is not satisfactory in every way, but is the most satisfactory yet designed and recommended to the Society. It is recommended to the Society only until a more satisfactory one has been designed and adopted by the Society. The most satisfactory tintometer of this type is offered as the Emil Greiner Company's Constant Light Colorimeter.

4—That only artificial light produced by 100 Watt Blue Frosted Electric bulb be allowed. It is necessary to make this change as the manufacturers have discontinued making the 75 Watt daylight blue lamp.

5—That the Society adopt the tube for holding the samples of oil to be examined, eliminating from the rule the glass oil sample bottle.

6—The Committee feels that the question of filter paper is a problem for the Refining Committee as well as the Color Committee. There is evidence that on off oils, cold pressed oils, and oils not refined 'clear' that the type of filter paper makes a great deal of difference in color. When oils are refined perfectly 'clear' the type of filter paper is not so important. At the present, it is sufficient to recommend a good heavy grade, close texture, white paper.

The following changes in the method are submitted for your approval:

Present Method:

(a) Apparatus—Tintometer consisting of a light-proof box with dull black interior, containing a 75-watt "daylight" electric light bulb, with a block of magnesia with white reflecting surface set at a proper angle to reflect the light vertically upward through the tube containing the sample of oil and through the standard color glasses alongside the tube of oil, and receptacles for holding the tube of oil and the color glasses. An eyepiece fits over the oil tube and color glasses so that the light passing through both may be observed simultaneously.

Suggested Change:

(a) Apparatus—Enclosed Wesson Type Tintometer consisting of a light proof box with dull black interior containing 100 Watt Blue Frosted Electric Light bulb, a block of magnesia with white reflecting surface set at a proper angle to reflect the light vertically upward through the tube containing the sample of oil and through the standard color glasses alongside the tube of oil, and receptacles for holding the tube of oil and the color glasses. An eyepiece fits over the oil tube and color glasses so that the light passing through both may be observed simultaneously.

Present Method:

Lovibond Standard Color Glasses—Red and yellow, of suitable numbers to match the color of the oils to be examined. (Red glasses to be standardized by U. S. Bureau of Standards.)

Suggested Change:

Lovibond Standard Set of Color Glasses—The standard set shall consist of the following numbers of red and yellow glasses:

Yellow:	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	35.0	and 50.0
Red:	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	2.0
	2.5	3.0	3.5	4.0	5.0	6.0	7.0	7.6	8.0	9.0	10.0
	11.0	12.0	16.0	and	20.0						

All red glasses to be standardized by U. S. Bureau of Standards.

Present Method:

Glass Oil Sample Bottles or Tubes, for holding the samples of oil to be examined. These must have a flat, smooth, polished bottom of clear colorless glass, not less than ¾ inch inside diameter and provided with a mark to indicate an oil column 5¼ inches in depth.

Suggested Change:

Tubes for holding the samples of oil to be examined—These must have a flat, smooth, polished bottom of clear colorless glass, not less than ¾ inch inside diameter and provided with a mark to indicate an oil column 5¼ inches in depth.

Present Method:

(b) Determination—Fill a tube or bottle (see paragraph above) with the oil to be examined to a depth of 5¼ inches. Oil must be at a temperature of 20° to 24° C. and must be clear and transparent. Filter through white filter paper at 20° to 24°C. if necessary to remove turbidity to permit matching the color, and in such cases note on your report that filtering was necessary. If, however, the oil or fat under examination is not completely liquid at 20°C., heat until completely liquefied, and read the color at a temperature not more than 10°C. above that at which it becomes completely liquefied. Place the tube containing the oil in the tintometer and place alongside of it such yellow and red color glasses (see paragraph [a]) as are necessary for making the comparison desired, observing the colors of the oil and the glasses through the eyepiece. Only one yellow glass and one red glass must be used to match the color of the oil in every case where color standards are mentioned to establish the grade. Report the numbers of the yellow and red glasses which match the color of the oil; or if a standard combination is specified to be used (as prime for example), report whether the oil is prime or off as compared with the standard.

Suggested Change:

(b) Determination—Fill a tube (see paragraph above) with the oil to be examined, to a depth of 5¼ inches. Oil must be at a temperature of 20° to 24°C. and must be clear and transparent. Filter through good heavy grade, close texture, white filter paper at 20° to 24°C. if necessary to remove turbidity to permit matching the color, and in such cases note on report that filtering was necessary. If, however, the oil or fat under examination is not completely liquid at 20°C., heat until completely liquefied, and read the color at a temperature not more than 10°C. above that at which it becomes completely liquefied. Place the tube containing the oil in the tintometer and place alongside of it such yellow and red color glasses (see paragraph [a]) as are necessary for making the comparison desired, observing the colors of the oil and the glasses through the eyepiece. In matching the color, use only one yellow glass, not more than two red glasses up to and including 13.0 red, and not more than three red glasses above 13.0 red. Report the numbers of the yellow and red glasses which match the color of the oil; or if a standard combination is specified (as prime for example) report whether the oil is prime or off as compared with the standard.

Note: Mr. Agee does not agree in recommending a given type tintometer.

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Dr. Deane B. Judd, of the Bureau of Standards, U. S. Department of Commerce, has completed some experiments on the effect of temperature changes on Lovibond color glasses. The effect of increasing the temperature of the glasses is to shift the curve of spectral transmission somewhat toward the red. Both yellow and red glasses show this sort of shift. The shift for a 35 yellow glass is four or five times as great as that for a 7.2 red glass. The difference is almost negligible in the color grading of cottonseed oil. *Bur. Stand. J. Res.* 1,859-66 (1928).